Developing Stratagies for successful Science and Technology programmes in Open Universities of Developing countries

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INTRODUCTION

As human civilization progresses from one era to another era the education and its delivery also undergoes changes and transformations as per the experience and needs of the society of that era. The present day system had arisen and developed as per Humboldt's or Newman's vision born of the experience of nineteenth century. Since then there has been revolutionary developments lead by science and technology in all spheres of human life giving rise to a society based on knowledge and knowledge workers which is far more than a social change and considered to create changes in the human condition (Drucker, 1994). As Magrath (2006) says the 21st century University which has great educational and intellectual talents within its faculty and staff is an educational enterprise and must use the educational talents available to serve society. We may say in line with this, there are some important concepts and models evolving to make education nearer to societal needs – university-industry collaboration/cooperation, mode1 & 2 models, triple helix, National innovation systems, regional innovation systems, higher education for sustainable development, consortium & cluster concept, public-private-panchayat partnership, skill development mission, finishing schools, university outreach and engagement, open and distance learning, corporate education, service learning, community learning, scholarship of engagement, centres of excellence and relevance, community colleges etc.

One of the developments which saw large expansion with respect to India is Open University (OU) concept. Though the potential of open distance learning system (ODL) in addressing higher education needs of the society is well argued in the literature, there is still skepticism about the legitimacy of distance education in countries as different as Swaziland, China, Canada and some European countries (Harry & Perraton, 1999). It is not surprising that the ODL system is often considered as 'second chance' and even'second grade' system in developing countries like India. This may be mainly due to the fact that the system's potential is being focused often on providing access to education (*making the open distance learning as an alternative system of education*) rather than for meeting the needs and demands of knowledge society and knowledge economy (*making open distance learning an essential system of education*). As Gidley et al (2010) point out access, which is often treated synonymous with social inclusion, is only the first step in providing higher education. Along with the access, success is an important aspect in social inclusion. The third concept introduced by them, participation is an important

factor in knowledge society where knowledge production is socially distributed and subject to multiple accountabilities. All these three concepts (access, participation and success) can be seen to reflect degrees of social inclusion and we need to see that ODL system cover these three concepts to move to the realm of knowledge society. Narasimharao and Nair (2010) while discussing universities and corporate education concludes that the 21st century social responsibility of universities in developing countries lies in broader involvement of universities with society by developing strategies to integrate the recent trends in higher education to make the universities to link to their place and also to integrate entrepreneurial and traditional functions needed for the well being of the society. The present paper discusses on developing strategies for successful science and technology (S & T) programmes in open universities of developing countries.

OPEN DISTANCE LEARNING AND SCIENCE EDUCATION

Narasimharao (2000) listed some of the advantages of open learning approach to food industries – training packages for local, specific needs, adopt to changing needs, target specific courses/programmes, more defined work procedures and methodologies, mass scale production of learning materials, tailor-made packages, reach trainees spread over a wide area, meets the demands of even small group of learners, study at home or at work place, accommodating various learning styles, no need of separate infrastructure, and training at work place. However, when we analyze the data presented in tables 1a & 1b on some of the science & technology courses through distance mode in India, it can be deduced that most of them are just imitation of courses offered in conventional mode. Though we can say that there is progressive evolution from the initial stages of arguing and convincing that science education programmes can be done through open and distance learning systems (Narasimharao, 1993, Panda et al 1998) to offering of highly specialized subjects, it is only useful in providing access and not for achieving social inclusion as per Gidley et al (2010). Discussing development of distance education in commonwealth Asia, Tahir (2001) identified the role of distance education within higher education as – 'second chance' upgrading, information and education campaigns for large audiences, speedy and efficient training of key target groups, education for otherwise neglected target group, expanding the capacity for education in new areas, expanding geographical access to education, the combination of education with work and family life, and multiple competencies.

When we analyze open distance learning programmes and their success, on one hand they gained importance all over the world and on the other hand they are still treated as 'second grade' in the market particularly in developing countries like India. Several factors may be attributed for this and some of the major factors we identify are:

- Many in other places still equating open distance education with correspondence education and not taking into account the developments in the use of modern communication technologies and the pedagogies.
- Some of the science programmes of open distance learning institutes not providing the required inputs in terms of interactivity and in terms of practical activity (see Narasimharao, 1993, Narasimharao & Soundaravalli, 1995)[1] and not using modern communication technologies and pedagogies.
- Students not being able to exploit the teacher in built activities in self instructional material which are the main inputs in developing countries like India (Narasimharao, 1999)

- Though there is lot of interest among industries in using open learning (Temple, 1991; Trindadem, 1993; Brown, 1997)) and seen as a viable alternative to overcome problems like skill shortage and the need to retrain and upgrade the existing workforce, it is yet to be applied in a meaningful and elaborate way in India and other developing countries.
- Some of the general myths and misconceptions prevalent about open distance learning system [2] resulting in poor repetitions of courses which are offered in regular university system.
- The concept of open and distance education is to provide some thing more than just learning resources which are learner centered. They need to support local needs and identify community education programmes[3].
- Traditionally, science teaching has been limited to preparing student for research career in science at the university level. Open universities just imitating the courses of conventional education system can only be said of doing the same thing.
- The hierarchical approach to education (Pyramid structure) treating each stage of education as a preparation for next stage created more unemployable youth in developing countries[4] and perhaps by imitating the same approach the open universities are adding to the number of unemployable youth.

In order to address these issues and come out of the traditional mode to cope up with the various developments and demands of knowledge society the ODL system can take a cue from the significant transformations and reforms taking place in tertiary education systems of many countries to become part of the surrounding society rather than remaining as isolated ivory towers (see Thulstrup et al. 2005).

KNOWLEDGE BASED ECONOMY AND MOVING BEYOND TRADITIONAL OPEN DISTANCE EDUCATION

The World Bank proposed a widely used Knowledge Based Economy (KBE) model that identifies four pillars of KBE :

1. Education, including building a skilled workforce
2. National innovation systems, including science and technology, research and development (R&D)
3. Building networks, including ICT infrastructure and social networks
4. Policy and regulatory environment.

For open distance learning to launch and deliver successful science and technology programmes they need to take into account these four pillars and build them into their strategies.

We can derive strategies for moving beyond the traditional open distance education under three broad heads – innovations, borderless education and approaches. Under innovations we need to deal with technologies, pedagogies and societal context. Borderless education may cover convergence of all systems, making disciplinary boundaries and the education systems more porous, integrating traditional knowledge and modern knowledge, knowledge management and knowledge integration. For achieving these we can follow different approaches like collaboration and net working (sharing of resources), outreach and engagement (scholarly engagement), sustainable education (balancing market forces), corporate education (triple helix) and skill development and engagement (community engagement).

We may relate the four pillars of KBE to these approaches though strict compartmentalization is not possible. Outreach and engagement may be beneficial in building skilled workforce, education and building net works; corporate education may be useful in building the national innovation systems; community engagement and collaboration & net working may be useful for building networks including social net works and regional innovation systems; sustainable education for building ecosystems. We will be broadly discussing these for evolving strategies which may help in open universities moving beyond traditional distance education system.

OUTREACH PROGRAMMES and EDUCATION, INCLUDING BUILDING A SKILLED WORK FORCE

One of the concepts which open universities can adopt for launching successful science and technology programmes is university outreach programmes. Magrath (2006) gives a good idea of outreach programmes.

> "Personally I prefer Engagement, but have little interest in debating labels and terminology. What ultimately counts is the concept of a major state university being in partnership with its community, its state and region, and, yes, the wider world with which we are inextricably involved in this new globalized environment. Ultimately all that counts is what we do in effective working partnerships with businesses, civic organizations, government agencies, and, indeed, other colleges and universities. Everything we do in this future--which is here right now--must involve the fundamental responsibility of educating men and women of all ages and from our diverse populations (we can call this learning); discovering new knowledge and applying it (typically labeled research); and providing service to society."

This is in essence same as that Boyer (1996) gives for a successful professoriate. He describes four "interlocking functions" - scholarship *of discovery* (basic research), *scholarship of integration* (placing discoveries within a larger context) *scholarship of sharing knowledge* (communal nature of scholarship) and *application of knowledge* (as a reflective practice in which theory and practice inform each other). When we analyze how open universities carries out its functions (refer Otto Peters industrial model) we may say compared to conventional regular universities they depend on a large faculty/experts outside their regular employee rolls. This may make it easier to implement outreach programme concept. From an analysis of outreach courses and their diversity, we can deduce that outreach would help universities to incorporate recent developments in higher education, and also address various issues: the concept of community development through participation and collaboration with community leaders; interaction and collaboration between universities, industries and business organisations; student employability; the problem arising from universities becoming a business partner; building up relevant knowledge;bringing students closer to real-life situations; balancing between basic and applied knowledge and research and provisions for lifelong learning. It also encompasses various delivery models like face-to-face education, distance education, open learning, corporate university, online learning, and multimedia learning (Narasimharao, 2009a). Though outreach and engagement is widely practiced by many institutes of high repute all over the world, they are still in nascent form and need to evolve in developing countries like India and are loosely used in many contexts[5, 6]. We need to develop mechanisms to introduce the outreach concept as envisaged by Boyer in open universities.

Relevance based approach and Systems approach

Education including building skilled work force in science and technology is a very important activity for nation development. For instance, biotechnology industry clusters around the world identify access to future employees and workforce development as the second or third most important item in a long list of hurdles facing their companies on the road to commercialization (Dahms, 2003). The problem also lies in our producing unemployable graduates or biotechnologists. As Senge (1990) puts "Perhaps, for the first time in history, humankind has the capacity to create for more information than anyone can absorb, to foster far greater independency than anyone can manage, and to accelerate change far faster than anyone's ability to keep pace. Certainly the scale of complexity is without precedent." Universities should be able to decide on what and how much knowledge is to be imparted or disseminated to a particular target group. Though there are many approaches to managing information overload (Narasimharao, 2010), they may be effective only when we expand our boundaries of scholarship. Outreach programmes may help in this direction. They not only take a relevance based approach (Narasimharao & Sridhar, 2007) but also take care of compartmentalization of knowledge. Course team approach of Open University system may help in building skilled man power having appropriate skills. For instance we can involve faculty from different disciplines, experts/managers from industry, government, local bodies etc in designing the curriculum and in delivery of the course. This way we will be able to prepare for a particular technical skill. For example, the elements of biotechnology workforce development are split among a variety of regional, city, country, and state governmental organizations that play differing roles depending upon the level of their expertise and attention (unemployed workers, displaced workers, vocational-educational, entry level, school-to-career, welfare-to-work, community college, senior higher education, etc.) (Dahms 2003). There are various industries, organizations and the societal bodies which need biotechnology education in some way or other. This implies that we need to give inputs of biotechnology to many social groups and working groups depending on their needs. A similar thing we can observe in Chemistry and chemical industries or in many science and technology subjects. The systems approach to course development followed by OU with needs analysis, options available, environment etc (see Reid, 1998) helps in providing correct inputs for developing relevant courses and the course content.

Linker Unit concept

Narasimharao (2009a) proposed a model for community and economic development through outreach programmes with university outreach centre as a 'linker unit' for integrated development of formal and informal knowledge and creating knowledge capital network. In this model the University will have a linker unit like University centre for outreach which will coordinate and collaborate the activities of university in relation to local community needs. The advisory committee of stake holders in association with the university centre for outreach would identify the issues, capacities and needs of the community. Based on the inputs and the evaluation of issues and implementation of strategies the university centre will develop university outreach programmes using the knowledge capital network (of

all players) developed. Konde (2007) discussed the role of 'linker units' in triple helix model that mobilize university, government and industry/partner resources to create and incubate businesses. Beerkens (2009) argues that there is a worldwide convergence towards a global model of centre of excellence and relevance (CER) where they are moving towards a specific spectrum of technologies (such as the NBIC[7] technologies). They are organizationally integrating research, development and commercialization and are increasingly connected with governmental and industrial partners. We can identify or establish different linker units like non governmental organizations (NGO), government departments, community development centres, continuing and adult education centres, extension education centres, centre of excellence and relevance for a particular field etc., for linking universities and other stakeholders of S &T. Open universities with their flexible and systems approach can develop appropriate models as per the requirement.

Collaborations and community outreach

At Present, there are 497 universities in the country including 240 state universities, 130 deemed universities, 40 central universities, 49 private universities and 38 institutes of national importance (Universities Handbook, AIU, 2010). There are number of colleges under each universities covering rural and urban areas. If each of these colleges are connected to their communities the universities can reach out to society. For instance, very near to the engineering colleges, villages are affected due to inadequate water supply and poor sanitation. It could be solved very easily by the intervention of the engineering colleges. However, the staff of the colleges are career oriented and do not connect themselves with the society. We need to evolve institutional mechanisms to overcome this problem. The convergence concept introduced by IGNOU may be useful to integrate the open university concept with traditional colleges for evolving institution mechanisms for community outreach. Open universities with their wide net work concept may be able to make outreach programmes for having more local/regional based courses to serve the economic and societal needs of the region. For example, Portland State University, not a research intensive university but a significant urban one, has an extensive community-based teaching and learning program in which it has community-based learning courses exceeding 150 and in approximately 23 departments. These courses started out as traditional disciplinary courses, but had been transformed by integration of community work with a direct relation to the academic content. Similarly Virginia Tech University also has started many unique outreach engagements in association with many partners (Magrath, 2006). Open universities can plan many science and technology programmes through outreach concept by integrating community work with academic content and by collaborating with other organizations. University of Mysore in 2006 started a separate centre for outreach programmes and established collaborations with various stakeholders including NGOs, IT industry, clinical research, animation industry etc. Karnataka State Open University recently has certain tie ups with outside agencies for providing some programmes in partnership. Some of them are - Executive MBA, Bachelor of Business Administration in Aviation BBAA,MBAA, PG diplomas in Hardware & Networking, advanced software technology, Bachelor of Fine Arts (BFA), PG diplomas in Nursing related courses, PG diploma in creative teaching, certificate courses in jewellery design, cryptography and network security, multi-media and wireless communication, distributed computing,

M.Sc. in biotechnology, microbiology, biochemistry, environmental science, courses related to hotel management, fashion design, pottery, hanloom, stone carving, cane and bamboo works, pre-school education, PG diploma in security analysis & portfolio management, real estate management, BSc in animation etc. Similarly IGNOU has entered into a number of MoUs with other organizations for offering various programmes in collaboration (see IGNOU, 2010). However, we need to evaluate these programmes closely to see whether through them the colleges and universities are establishing effective linkages with the society as per outreach concept of Boyer (1996) and Magrath (2006).

CORPORATE EDUCATION AND NATIONAL INNOVATION SYSTEMS

Corporate education is increasingly gaining much importance and attention as the world started experiencing transition from production based economy to knowledge based economy with the knowledge workers becoming key factors for the growth and development of organizations and societies. We can broadly categorize the developments on university's role to society into generative and developmental approaches. Gunasekara (2006) relates these two approaches to triple helix model and university engagement. While triple helix model focuses more on economic development, university engagement literature takes more developmental view while acknowledging the academic entrepreneurial activities. To effectively overcome the entrepreneurial & market influences, we need to develop strategies for integrating entrepreneurial university into traditional university. Narasimharao and Nair (2010) discussed these under four broad heads – avoiding compartmentalization of knowledge, reaching out to society, need for change in approach & attitude, and catering to regional needs. They conclude that universities need to broaden their scope and coverage and this cannot be done very easily as there are several factors involved including the necessity for change from within and the general difficulty in deviating from the traditional path for both academics and other stake holders. Open universities with their net working ability can evolve new strategies for science and technology programmes which form core for the development of new industries/ new products.

National Innovation System (NIS)

Over the last two decades, the concept of 'National Innovation System' (NIS) has evolved as a framework for analyzing the role of innovation in economic development at the national and regional levels (Edquist, 1997; Lundvall, 1992). The successful functioning of the NIS depends on how institutions interact with one another and extend support. Metcalfe (1995) refers to the NIS as 'a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies'. The social capital of the innovation system influences its significance as how the different component parts interactively perform as a dynamic whole together rather than the excellence of the individual components of the system. This can further be elaborate from figure 2 which gives the framework of the science and technology strategic plan (2004-13) of Thailand enumerating five strategies for improving the Thai economy which may be applicable for other developing countries. It is stated that the typical feature of the innovation system in developing countries is that the major actors in it are often observed to be compartmentalized and isolated from each other (Yokakul and Zawdie,

2009). To overcome this compartmentalization and isolated action the open university concept will be helpful.

Partnering

One important strategy for corporate education development of NIS is partnering. Though open universities partner with conventional institutes to share resources and infrastructure, we are talking of more strategic partnership of planning, execution and development (future and present). For instance the Biotech Consortium India Limited (BCIL) net working covers universities, central & state governments, Research institutions, International organizations, funding institutions, industry, resource persons and entrepreneurs (http://bcil.nic.in). The Scottish colleges biotechnology consortium (SCBC) supports biotechnology activities from the schools sector to industry. Similarly, the Bay Area Biotechnology Education Consortium (BABEC) is a regional network of local science education organizations based in North California Bay area. To accomplish their mission, BABEC and its partnerships work with teachers, educators, scientists, industry and academia to develop, disseminate, implement, and sustain contemporary laboratory-based biotechnology curricula that increases professional skills of the classroom teacher, capture the interest and challenge the capabilities of students. IGNOU has recently partnered with many organizations and industries to offer various programmes. Similarly other universities including KSOU have recently entered into partnership mode. However, like in Thai NIS we need to define strategies in such partnerships and see that all stakeholders are involved.

Hybrid disciplines

We need to develop hybrid disciplines to suit corporate education needs and to suit the NIS. There is much research going on in multidisciplinary approaches. For example Okuwada *(2006*) mapped the relation among the 153 rapidly developing areas covering various disciplines like mathematics, space science, psychology, economics, material science, life sciences, molecular biology, engineering, agriculture, geosciences, chemistry etc.,. Universities should be able to develop courses which integrate the knowledge from different disciplines. Reputed universities like Harvard university, MIT, University of Cambridge, Australian National University, University of Melbourn etc offer some out of the box innovative offbeat courses (see Dongre & Narasimharao, 2010). Open universities like IGNOU, KSOU, YCMOU, and some distance education institutes also recently planned many offbeat courses covering various target groups. However, the poor enrolment in these courses warrant for some new strategies to make these courses successful. We can learn from the fact that small firms, despite their size and resource constraints, create more innovations than large firms (Cohen & Klepper, 1996). Researchers attribute this paradox to the ability of small firms to develop and enhance their social capital through

cooperation, collaboration and networking with other actors in the NIS. Open universities we can say are strong in their social capital interacting and associating with many stakeholders of higher education and should be able to use this social capital for designing and developing successful science and technology programmes. This helps us in creating or developing hybrid disciplines useful in the context fo NIS.

Continuously developing or modifying curriculum

One of the key factors for the success of NIS is the social capital or the ability of various components of the innovation system to interact with each other. In developing countries the triple helix system being less efficient is attributed to major actors being compartmentalized and isolated from each other. It is crucial that the educational system overcome this issue of compartmentalization for the success of NIS. However, education system in India has certain traditional practices and policies like fragmenting our educational enterprise into cubicles, not thinking beyond the boundaries of disciplines, emphasis on delivery of information and storing information rather than on creativity, imagination and knowledge creation (Yashpal, 2009). In order to keep pace with knowledge explosion we have transformed our curriculum to incorporate new sciences like molecular biology, genetics and genomics; In this approach we want to cover as much knowledge as possible for our graduates and introduce more and more recent developments (Gundersen, 2003) focusing more on information than on creativity. Added to this we have issues like multidisciplinary nature of knowledge, territorial behavior of faculty building strong disciplinary walls, universities creating courses which are popular without necessary regard for academic rigor or societal needs; academics developing their own research specialism as a mechanism for career progression. Yashpal committee (2009) in concluding their report on renovation and rejuvenation of higher education in India suggest that there should be an educational movement to continuously articulate and debate the issues faced by higher education so that changes are made in keeping with the emerging trends nationally and globally on the most effective forms of higher education. Open universities with their ability to incorporate various forms of higher education should see that their systems allow constant interaction with other players of NIS and continuously modify the curriculum as per the changing needs. It is not so much the component parts of the innovation system that make it significant, but how these interactively perform as a dynamic whole together is more important.

BUILDING NET WORKS AND REGIONAL INNOVATION SYSTEMS

Creation of knowledge networks including ICT infrastructure and social net works which is one of the four pillars of KBE is a big challenge faced by the developing countries. In this connection we also need to take into consideration the dynamics of knowledge transfer. For local economic development it is essential that we identify the local needs and develop local capacity. United Nations Advisory Committee on Science and Technology for Development in its report of 1989 observed:

> "The essence and implications of creating an endogenous or local capacity … have continued to elude many countries and hence have not been sufficiently addressed in the mainstream of policy making, of planning or of execution of strategies for overall socio-economic development."

For building networks and creating local capacity we need to develop regional innovation systems. For instance, since 1996, Japanese government formulated three successive science and technology basic plans outlining objectives for the regional level. In the current Third Science Basic Plan (2006-10) one of the core objectives is to promote academia-industry-government links at the regional level and support regional innovation through net work mechanisms. The two initiatives in this direction initiated since 2001 are 'Industrial Cluster Initiative' and the 'Knowledge Cluster initiative'(Kitagawa, 2009). Open universities with their net work concept can develop appropriate models for science and technology programmes at regional level. These may include strategies for improving rural higher education, developing social and human capital and creating opportunities for community level higher education.

Rural Higher Education

The rural higher education is a neglected subject in India mainly because we failed to concretely erect our educational system on Indian needs and ethos affecting the whole fabric of Indian society (Panickar, 2009). As argued earlier in the present day knowledge society universities need to be part of surrounding society which warrants for strategies for greater integration of rural India needs with university higher education. Mahatma Gandhi proposed 'Nai Talim' concept [8] for integrating academic learning with productive work. We consider that the modern regional innovation system (RIS) is more elaborate way to bring academic learning and productive work together. Palanithurai (2009) points out that we do not have an institutional mechanism to transfer the rich potential or extendables in the form of ideas, technologies and skills (of our educational institutions) to the rural communities. Open universities with the kind of flexibility and systems in place can plan strategies for evolving RIS. Through micro and macro planning involving village panchayat, block panchayat, district panchayat they can link local skills and their upgradation with local governance, rural health, rural education, environmental issues, agro products creating new forms of food security and marketing of rural produce. In this planning, the regional centres or local centres of open universities can play a prominent role integrating the activities of schools of studies or disciplines with rural needs. Some of the roles and responsibilities of regional centre academics can be identified as regional need based programmes for mission driven approaches, developing regional innovative systems for knowledge management, adjunct outreach strategies to bridge the gap between planning centrally and acting locally, strategies for utilizing academic expertise available locally, strategies to meet the demands of diversity and limitation of variance in the levels of development of different regions, strategies for technology enabled learning under rural India conditions etc. There are programmes designed for rural India by IGNOU and other open universities. In this connection, what Morgan (Dr. Radhakrishnan committee report, 1949) points out for conventional universities are to be taken into account. He states that the whole education system was devised to prepare personnel for government jobs and not for social transformations. Since science and technology developments are the backbone of present day civilization we need to design S&T programmes to develop trained personnel who are self reliant and contribute for the development of rural economy.

Social Capital and Human capital

Chaminade and Vang (2008) discusses the influence of social capital and human capital for effecting interactive learning (and thus knowledge integration) with local and external sources of knowledge. The knowledge integration should be a two way process. For example, through outreach programmes the relevant knowledge from Universities may be integrated into a particular section of people in the society and in turn universities should be able to integrate the tacit and practical knowledge of the people into their basic knowledge. In other words, acquire or integrate knowledge and competencies through collaborations and interactions. Knowledge development through human capital at the regional level is basic to the strengthening of knowledge economy. The participation of local and national governments, community level bodies, non-government organizations, international agencies, local small and medium-sized enterprises in such partnerships with the university is crucial to the successful development of a regional level knowledge economy through social capital.

Community colleges

One of the concepts IGNOU has adopted is community colleges. Through these colleges, the large number of vocational and skill oriented programmes of IGNOU through face to face, mixed convergent mode, and technology augmented mode can be provided in the areas of technical/occupational programmes, remedial education, continuing education and workforce development contextualized to the requirement of the community in the region. What former Prime Minister of India, P.V. Narasimharao (1995) said while inaugurating National Council for Rural Institutions (NCRI) is applicable here. The whole argument was to contextualize the Rural Institutes: they have to create cadres to manage development programmes. The cadres coming out from Rural Institutes should not be job hunters but job creators. The Rural Universities have to act as catalysts to help the communities through ideas, knowledge, skills and technology. Community colleges when start functioning in this direction can help village level functionaries, governance, active groups like SHGs (self help groups), NGOs, farmers, artisans, pottery workers etc. Community colleges should realize that rural reconstruction and rural transformation need a totally different governance system, administrative system, livelihood system, economic system, credit system for which a new set of cadres are needed. The OU can evolve strategies for programmes relevant to rural health, sanitation, rural industries, culture, indigenous medical systems, natural resources, environment, rural management, energy sciences, socio political studies etc. In this we need to follow relevant based approach discussed above rather than discipline based approach.

ECOSYSTEM AND SUSTAINABLE EDUCATION

Effective and all-encompassing ecosystems are essential in KBE for sustainable education at all levels. In the ecosystem the open universities have to position themselves for useful contributions. Narasimharao (2010b) while discussing corporate education in tertiary education system presents how a centre for corporate education of University or tertiary higher education institute would help in the ecosystem for knowledge linkage and integration. In this model the traditional knowledge of the society is to be linked

to various knowledge sources like universities, research institutes, vocational training and proactive corporate which in turn focus on development of human resources with domain specific knowledge, transferable skills, managerial & interpersonal skills and social skills with the capability of creating social capital. These are linked to University corporate education centres through incubators which receive innovations from diverse sources. The university and college corporate education centres with the help of intellectual and material resources available at university/college level will be strengthening the four pillars of knowledge based economy – building skilled work force, creating knowledge net works, participating in national innovation system, creating regulatory environment and appropriate ecosystems. These activities in turn will have to be connected to industry needs (changes in product markers, improvement in existing products and processes, new products & processes, background knowledge and economics). They also have to take into account of various levels of industries (large domestic firms, transnational companies, small and medium sized enterprises, regional level firm and startups), industry players and their needs (Figure 3). Narasimharao and Anand (2009) while discussing new approaches for universities to reach out to society with regard to algal technologies concluded that for making the potential of algal technologies transfer to field level we need new approaches which will take care -

- Knowledge explosion vs knowledge fragmentation,
- Designing subject areas in isolation vs multidisciplinary/interdisciplinary trends
- Universities as knowledge houses vs increasing tendencies to treat teaching & research as separate activities
- Learning across disciplines vs specialized studies
- Convergence of technologies and knowledge
- Globalization of knowledge vs regional/local/traditional knowledge
- Vocational education vs university education

When we develop ecosystems we need to see that they facilitate addressing these issues through various mechanisms.

CONCLUSIONS

The urgent need for renovating and rejuvenation of our higher education system is evident in the reports of recent high level committees - Yashpal committee to advise on Renovation and Rejuvenation of Higher Education (2009) and Knowledge commission headed by Sam Pitroda (2007). There is also concern that in spite of many recommendations and well acclaimed vision of various education commissions[9], higher education system still faces many burning issues. This is evident from the fact that what Kothari commission said about four and half decades back is still valid today. The commission said: "No reforms are more important and more urgent than to transform education to endeavor to related to life, needs and aspirations of the people and thereby make it a powerful instrument of social, economic, and cultural transformation necessary for realisation of our National goals." In 2007 the National Knowledge Commission expressed similar concern. It said:

> 'It is clear that the system of higher education in India faces serious challenges. And it needs a systematic overhaul, so that we can educate much larger numbers without diluting academic standards. This is imperative because the transformation of economy and society in the twenty-first century would depend, in significant part, on the spread and the quality of education among our people, particularly in the sphere of higher education. It is only an inclusive society that can provide the foundations for a knowledge society....' (http://www. Knowledgecommission.gov.in)

Kulandaiswamy (2002) states that we academics have somehow resisted change and avoided mini revolutions. A major revolution is now on the horizon and we must prepare ourselves. He also says distance education is a new tool and a modern tool. The power of the tool is not in the tool but in the hands of the user. A tool is as powerful as the imagination and ingenuity of the craftsman, he adds.

When we see the evolution of open distance learning system in India, it is mostly following the foot steps of conventional system except for the delivery of courses and use of multi media in some cases. Being new education system it has the advantage of evolving new mechanisms and systems. There are many factors which influenced it to follow the footsteps of the conventional system of education. This has made it in the public opinion second fiddle to the conventional education system. As Kulandaiswamy pointed out it has a great potential and it can be tapped as per imagination and ingenuity of the user. We can use this system for more social inclusion covering access, success and participation. The system has to move from its traditional education system into the realm of Knowledge society and knowledge based economy which is possible when we use the full potential of the system. We propose that this can happen by covering three broad strategies – innovations, borderless education and approaches.

With knowledge based economy establishing itself a broader vision of career goals in science education is now being sought, one that enables students to actively participate in the economic affairs of the nation as a more productive person in the workplace. The goal is common for all students, not just limited to those who choose to become a scientist. The educational issue arises from evolutionary changes that are taking place in the practice of science, the development of a global economy, the nation's entrance into an Information Age, and the changing nature of the workplace (Hurd, 1998). Knowledge based economy's four pillars as identified by World Bank are to be part of our strategies if we want to move to the realm of knowledge society. Open universities need to think out of the box to become part of these four pillars. We propose different mechanisms/strategies for this particularly with reference to science and technology programmes. University outreach is one of the main strategies for education including building skilled man power. These strategies should also help in our not producing unemployable graduates. For instance it is observed that on the one hand, the biotechnology industry is starved of talent and, on the other hand, there are many unemployable biotechnologists and general graduates particularly with reference to developing countries (Narasimharao, 2010a). Though outreach was emphasized in the tenth plan of UGC not many universities have taken a cue out of this. Further, we need to ensure that outreach programmes are not just offering some course outside the jurisdiction of the university but to provide opportunities to extend and share ideas, information, technology, skill,

capacity and so on with the communities outside the university system. We have proposed three strategies for making this to happen – relevance based approach and systems approach, Linker unit concept, and collaborations and community outreach. The second pillar National innovation systems, we argue can be incorporated into ODL system through corporate education. Many industries being science based corporate education is an important concept for developing strategies for NIS. A cursory overview of microbial technology for human needs gives an idea of the impact of S &T for society. Some of the major products are related to medicine, agriculture, food products, chemicals, and environment management and allergenic. It is rather imperative to focus upon important and novel academically based, society/industry-engaged, and society/industry – responsive S&T education and training programs that provide impetus to knowledge economy particularly with reference to developing countries like India. These programs should link industry, community, research organization and institutes of higher education in novel partnership mode that ensures equal role/responsibility for each of the player in the bigger picture of development of science & technology and its application and utilization for the benefit of society. The three strategies proposed for OUs are partnering, developing hybrid disciplines and continuously developing and modifying curriculum. Creation of knowledge networks including ICT infrastructure and social net works which is one of the four pillars of KBE can be promoted through regional innovation system. The importance of developing regional innovation system can be more clear from what Yashpal committee said about regional milieu –

"There should be sufficient room for the use of local data and resources to make the knowledge covered in the syllabus come alive as experience. This is required simply because engaging with the world surrounding us – both local and international- is an important aspect of learning, both as a means as well as an end. Knowledge- both theoretical and applied- when pursued with reference to the milieu is qualitatively different from knowledge, which is pursued in isolation from the surroundings."

We need to involve various sections of stake holders in designing and even in the delivery of programme. For example Moorpark College and local Biotechnology companies developed a strong collaboration that focused on providing a comprehensive education in Biotechnology at the community college level. Eight department heads from a local industry (Baxter Healthcare Corporation), numerous scientists and managers from Amgen company, administrators from Moorpark College, and faculty from Mathematics, Chemistry and Biology participated while designing a training program curriculum for industry purpose. Similarly, for people in professions like footwear, pottery, agriculture, and business etc. the local university/corporate education centre can give inputs through research relevant to local needs and based on the local resources. For developing regional innovation systems we need to integrate it with strategies for rural higher education, social and human capital, and community colleges.

Braskamp and Wergin (1997) observe that despite the numerous roles which higher education has played in the life and progress of society, campus is increasingly "viewed as a place where students get credentialed and faculty get tenured, while all the overall work of the academy does not seem particularly relevant to the nation's most pressing civic, social, economic and moral problems". They argue that higher education institutions need to reorient themselves as active partners with parents,

teachers, principals, community advocates, business leaders, community agencies and general citizenry. Our universities should expand the boundaries of their horizon to become broad purpose organizations to serve the present day society where knowledge boundaries are shifting and re-forming to create new frontiers and challenges. Many insistutes/universities of high repute are modifying their university system by introducing certain innovations and avoiding compartmentalization of different systems of education and following more flexible approach to focus on the objective to be achieved (see Salmi, 2005). For S & T programmes we can use various forms of education as shown in the case of biotechnology (Narasimharao 2009b) [10]. It is also necessary that we use these forms of education as per the requirement, target group, objective to be achieved and the resources available. We need to develop appropriate strategies and ecosystems.

Notes

1. Shin and Maxwell (2003) in their research study investigating factors related to student satisfaction and academic motivation in the area of distance science learning concludes that it is advisable for teachers, course developers, and instructional designers concerned with teaching science courses via distance education to strive to design their practical work in an engaging way so that student could have quality time with the activities, instructors, and peers.
2. Some of the general myths in applying open learning are - equating it to conventional correspondence courses which may create doubts in the minds of people about validity of offering practical and application oriented courses; presuming that open learning has to be done in isolation which prevents use of the open learning techniques in other situations like traditional training and on the job training; treating open learning as knowledge dissemination in a more elaborative and exhaustive (information overload) way which makes it difficult to think of simple solutions available for the practical problems; seeing open learning as a complex one and not using it in simple and relevant way and thus making the system irrelevant in some cases; equating open learning with the application of ICT and other modern communication technologies which may lead people to focus more on technologies rather than using the concept for focusing on solutions to the problems of education and training; presuming that open learning should be always successful, often forgetting the fact that it is only a concept and its success depends on how best we can conceive and implement (Narasimharao, 2009b)

3. The European Association of Distance Learning Universities (EADTU) through a project entitled DUNE (Distance Educational Network of Europe) utilize experiences gained through existing and novel programmes to enhance the development of distance education in an international context. They developed a course in Genetic engineering which is more than simply the delivery of education and training in genetic engineering using pre-prepared learning materials. The materials can be re-packaged to respond to local needs and identifying good practices(Leach et al. 1997).

4. According to National Council of Applied Economic Research (NCEAR), India has more than 12 million science and engineering graduates-of which 2 million are postgraduates and 100,000 are Ph.Ds. However, it is estimated only 10% of the graduates are employable. In 1993 the country's universities awarded roughly 5000 Ph.D.s in sciences including medicine and engineering, but only 1000 of them found jobs in industry that made use of their skill. A smaller number entered academia, with the rest settling for something outside their filed (Bagla, 1995).

5. "The university outreach should be based more on the concepts of collaboration and cooperation with all the players as equal partners with free flow of information between all the players[2]. Universities with their academic expertise evolve programmes/research that focus more on knowledge integration and knowledge

management at all levels and facilitate the use of academic capacity in practice and also in developing academic capacity based on the practice in real life situations." (Narasimharao, 2009a)

6. Scholarly engagement consists of research, teaching, integration and application scholarship that incorporates reciprocal practices of civic engagement into the production of knowledge. (Baker, 2004). The traditional concept of service learning is different from outreach and engagement in that the later emphasizes bidirectional interactions, reciprocity, and mutual respect (Simpson 2000*)* instead of one-way assistance or direction. This is considered "a new twist for higher education: the two-way street of interactions or partnerships between the academy and the outside world".

7. Some of the rapidly advancing and converging technologies are some times referred to by their acronym 'NBIC' technologies: nanotechnology, biotechnology and biomedicine, advanced computing and information technologies and cognitive neuroscience.

8. 'Nai Talim' is a scheme of educational programme designed by Mahatma Gandhi to prepare a self reliant community by orienting body, mind and soul. Gandhiji wanted productive work and academic learning to be brought together into one integrated educational programme.

9. Dr. Radhakrishnan committee report (1949), Shrimali committee (1955), Kothari commission (1966), Ramachandran's committee (1969), P.V. Narasimharao's new education policy (1986), modified NEP based on Acharya Ramamurti committee (1992)

10. We can discuss a number of new trends like open distance learning, internet, virtual universities, corporate universities, franchise universities, academic brokering, collaborations of universities, consortiums and clusters, university outreach programmes etc., in relation to biotechnology which can be tapped for the benefit of developing countries (Narasimharao 2009b) for all science and technology programmes.

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Table 1 a: **Some Science & Technology Programmes of Distance Education Institutions (Dual Mode)**

S.No.	Name of the Institute	Science & Technology Programmes on Offer
	Andhra University, Visakhapatnam, A.P. School of Distance Education	B.Sc., B.E. (Civil, Elect. & Electronics Engg.) Mech. Eng, Electronics & Common Engg.), B.Tech (Chemical Engg.), M.Sc. (Maths, Organic Chemistry, Physics, Botany, Zoology), M.A. Psychology
	Nagarjuna University, Guntur, A.P. Centre for Distance Education	B.Sc. (MPC, BZC, IT, Maths, Statistics, Computers) B.Sc. (Costume Design & Fashion Technology) M.Sc. (Maths, Botany, Zoology, Physics, Chemistry, Microbiology) M.A. Psychology PG. Diploma in Biotechnology, Bio informatics,, Hospital & Health Care Management
	Jawaharlal Nehru Technological University, Hyderabad	B.Tech (Civil Engg., Civil EEE, Mech. Engg., ECE, C.S))
	Kakatiya University, Warangal School of Distance Learning & Continuing Education	M.Sc. (Maths, Environmental Science, Psychology) Ph.D. (Environmental Science)
	Osmania University, Hyderabad Prof. G. Ram Reddy Centre for	M.Sc. (Maths, Statistics) M.A. Psychology

	Distance Education	MCA, B.A. (Maths & Statistics) P G Diploma (Mathematics, Computer Applications)
	Guwahati University, Guwahati, Assam Post Graduate Correspondence School	M.Sc. Maths PGDCA
	Kurukshetra University, Kurukshetra , Haryana Directorate of Correspondence Courses	B.Sc. (Internet Science, Information System) BCA M.Sc. (Maths, Geography, Computer Science)
	Manipal University (MAHE) Manipal, Karnataka Distance Education Wing	B.Sc. (MLT, MIT, HIA) PGDDM (for MBBS doctors)
	Mahatma Gandhi University, Kottayam, Kerala School of Distance Education	B.Sc. (Medical Psychology, Computer Science) BCA Bachelor in Fashion Technology M.Sc. (Maths, Information Technology)
	Jiwaji University, Gwalior, M.P. School of Studies in Distance Education	B.Sc. (Gen, Computer Science) M.A. (Geography) MBA (Rural Technology, Chemical Sales) PGDCA
	University of Mumbai, Mumbai Institute of Distance Education	M.Sc. (Maths, IT, Computer Science) MCA B.Sc. (IT, Computer Science)
	Guru Nank Dev University Amritsar, Punjab Centre for Distance Education	B.Sc. (IT) BCA M.Sc. (IT, Maths, Computer Science) PGDCA
	Sikkim Manipal University of Health Medical & Technological Sciences Gangtok, Sikkim Distance Education Wing	B.Sc. (IT, Applied Biotechnology, Fashion Design, Hospitality & Catering, Medical Imaging Technology, Medical Laboratory Technology, Multimedia, Teaching Technology) MBA (IT, Health Care Services) M.Sc. (IT, Telecom technology), Computer Science, Ecology & Environment, Disaster Mitigation, Sustainable Development, Total Quality Management) PG Diploma (Hardware & networking, IT, Computer Application, Bio Informatics) Diploma (Hospital Equipment maintenance, Health Information Administration, Hardware & Networking, IT, Medical Lab Technology, Ophthalmic Assistance, Patient Care Aid, Physiotherapy, radiology & Imaging Technology
	Annamalai University, Annamalai Nagar, Tamil Nadu Directorate of Distance Education	B.Sc. (Maths, Psychology, Computer Science, Applied Chemistry, Electronic science, Mathematics with Computer Applications, Physics, Botany, Zoology, IT, Visual Communication, Computer Science, Fashion Design, Textile Design, Interior Design, Hotel & Tourism, Electronic Science, Statistics, Operation & research, M.Sc (Maths, Physics, Chemistry, Zoology, Botany, IT, Software Engg. , & Management, applied Psychology, Bio Informatics, Computer Science, Electronic Science, Geo Informatics, Tourism) M.Phil in many traditional Science Disciplines: Diploma (Concrete technology & Design, Construction Management, Industrial Safety, Industrial Pollution & control, Industrial hygiene, horticulture nursery management, Bio pesticides & Bio fertilizers, Maintenance Engg. & management, Petroleum refineries, industrial

		bio tech, Energy Engg., Computer application, fashion design, textile design, interior design, quality management, Welding Engg. & technology, industrial automation, drives & control, embedded system & application, food preservation technology, marine engg., Food & nutrition, poultry management. PG Diploma (Petroleum exploration, Agriculture in marketing management, computer application, marine environment, marine microbial technology, agriculture, acturial statistics, computer aided design, dairy technology, plant protection, criminology forensic science, Electric & instrumentation, natural resources, automation and pollution control, electric safety & safety management, electric energy management, VLSI design, environmental management, health science in tobacco control, adolescent health, accupunture, medical costumology, ultrasonagraphy, family medicine, dialectology, medical laws & ethics, accident & emergencies, echocardiography, promoting relation drug use, pharmacy practice & drug store management
	Bharathiar University, Coimbatore, Tamil Nadu School of Distance Education	M.Sc. (Computer Science, Applied Psychology, Information Science & Management, Mathematics) B.Sc. (Fashion Design, Physcis, Visual Communication, Computer Science, Maths) MCA, BCA PG Diploma (Bio informatics, Advance Networking System) Microbial Technology, Computer application)
	Bharathidasan University Tiruchi, Tamil Nadu Centre for Distance Education	M.Sc (IT, Maths) MCA , B.Sc. (IT, Maths), BCA, M.Phil (Statistics, Physics, Chemistry, Botany, Zoology, Computer Science, Bio Technology, Bio Chemistry, Microbiology, Geography)
	University of Madras, Chennai Tamil Nadu Institute of Distance Education	B.Sc. (Maths, Geography, Psychology) BCA M.Sc. (Maths, Psychology, Geography, IT), MCA
	Jadavpur University, Kolkatta, West Bengal School of Education Technology	M.Tech IT (Courseware Engg,) PG Diploma in Multimedia and Web Technology
	Mother Teresa Women's University Kodaikanal, Tamil Nadu School of Distance Education	B.Sc (Psychology) BCA M.Sc. (Guidance & Counseling, Psychology) MCA Diploma in Food Production, Front Office Management PGDCA Ph.D (Computer Science, Maths, Physics, Food Nutrition, Geography, Psychology, Textile & Clothing) M.Phil (Computer Science, Food & Nutrition, Family Resource Management, Guidance & Counselling, Psychology

Source: Information base on distance education in India, 2007, Distance Education Council, IGNOU, New Delhi

Table 1 b**: Science and Technology Programmes offered by some Open Universities in India**

Dr. B.R. Ambedkar Open University, Hyderabad, A.P

B.Sc. in - Botany, Chemistry, Geology, Mathematics, Physics, Zoology (72 practicals in each subject) ***M.Sc*** in – Mathematics; ***PG diploma*** in - Environmental studies; ***Certificate*** in - Mushroom cultivation, computing

Vardhman Mahaveer Open University, Kota, Rajasthan

Diploma in - Computer in Office management, Nutrition & Health Education
Certificate in - Food & Nutrition, computer awareness

Nalanda Open University, Patna, Bihar

M.Sc. in – Botany, Chemsitry, Geography, Mathematics, Physics, Zoology; ***MCA;B.Sc. Hons*** **in** – Botany, Chemistry, Geography, Mathematics, Physics, Zoology, Home Science, ***BCA;Post graduate diploma*** in – Yogic studies; A***griculture Certificate courses*** in – Biofertilizer production, Floriculture technology, Medicinal & Aromatic Plants, Soil Health Management; ***Health & Environment Certificate courses*** in – Environment studies, Food & Nutrition, Health & Environment, HIV & Family Education; ***Paramedical Certificate courses*** in – Basic medical assistance & Nursing Care, Clinical Dental Technique, Dental Mechanic, Dental & Oral Hygiene, ECG technique, Medical laboratory technique, Optometry and Ophthalmic assistance, Operation theater assistantship, Physiotherapy and Yoga therapy, Radiography & Imaging technique; ***Certificate courses*** in – computing, home usages of computers, disaster management

Yashwantrao Chavan Maharashtra Open University, Nashik, Maharashtra

B.Sc. in IT, Agri Hort; ***B.Tech.*** Marine, Elect, Mech Engg; ***M.Sc.*** research methods, Agri (comu), Agri (extn), Agri (Dev); ***Electronics Engg Diploma*** in: computer tech, communication engg, instrumentation engg, indl electronics; ***Agriculture Diplomas*** in – fruit production, vegetable production, floriculture & landscape gardening, agri business mgt., ***Computer diplomas*** in – computer operations, office computing, computerized financial accounting, Printing & graphic arts, computer hardware maint & network; ***Certificate*** in – office computing, computerized financial accounting, entrepreneurship development in inf tech, DTP,CA, Computer operations, coputer preparatory skills, early child care, gardening.

Madhya Pradesh Bhoj Open University, Bhopal, Madhya Pradesh

B.Sc. – pass, Hons in – Maths, Physics, comp.sc, Nursing, Design, IT enabled services, IT; ***BCA;MCA; M.Sc.*** IT, Comp. sc., Physics, Chemisty, Maths, Botany, Zoology; M.Sc. (Hons) in Maths, comp. Sc.; ***PG diploma in*** – bioinformatics, chemoinformatics, computer applications, maternal & child health, hospital & health management, dietetics & therapeutic nutrition; ***Advanced PG diploma*** in - Computer applications; ***Advanced Diploma/Diploma/certificate*** in – computer application; ***Diploma*** in Nutrition and Health education; ***1 year Training Programme*** **-** Knowledge and Skill upgradation of Rural doctors & para medicals

Karnataka State Open University

Programmes offered under partnership with Avalon Aviation academy (**aviation courses)**, CMC Pvt. Ltd (**Computer courses)**, Dayananda Sagar Institution***(*Forensic Science*)***, Father Muller Charitable Institutions (**para medical*)***, JSS institutions (**Engineering**), Pooja Bhagvat Memorial Mhajana Education centre (**applied science courses**), Osteen academy (**fashion design)**, Pilikula Nisargadhama (**skill development courses)**, Sharada Vikas Trust (**computer)**, Toonskool (**animation)**, virtual education trust (**information technology);**

Post PUC diploma in – nutrition & health, environmental sicnece and management, information technology; ***Certificate courses*** in – science & technology, information technology, environmental technology, environmental management, solid waste management, computing, food & nutrition

Netaji Subhas Open University, Kolkatta, West Bengal

B.Sc. in Botany, Chemistry, Geography, Maths, Physics, Zoology; ***Certificate course*** in – computer application & programming, web design, information technology; 2 yr prgm in Web application development

Tamil Nadu Open University, Chennai, Tamil Nadu

B.Sc. Maths, Maths with computer applications, apparel & fashion design, Hospitality & hotel admn, Geography; ***M.Sc***. in Maths, counseling & psychotherapy, Psychology; ***PGDAH, PGDCA, BCA, MCA, PG dip*** in information tech, Psychological counseling; Advanced diploma in apparel & fashion design; ***Diplomas*** in refrigeration & air conditioning technician, house electrician, plumbing technician, catering assistant, four wheeler mechanism, design & garment making, home appliance repairing, mobile phone servicing, computer hardware servicing, animation, health assistant, multimedia system, computer application, early childhood care, food production food & beverages service, Bakery & confectionery; ***Certificate*** in – food & nutrition, teaching in primary school maths, environmental studies, accounting software & tally

Indira Gandhi National Open University

Offers several ***S&T programmes*** at different levels including awareness & non credit, certificate,diploma,advanced diploma, PG diploma, under graduate, post graduate and research level. It covers ***basic and applied sciences, computer sciences, agriculture, engineering, medical, para medical, skill development etc.*** It also has entered into MoU with several organizations to offer courses (www.ignou.ac.in).

Source: Universities Handbook, 2010 (32nd Edition), Association of Indian Universities, New Delhi

Figure 1 :

Role of University Outreach in Knowledge economy Development

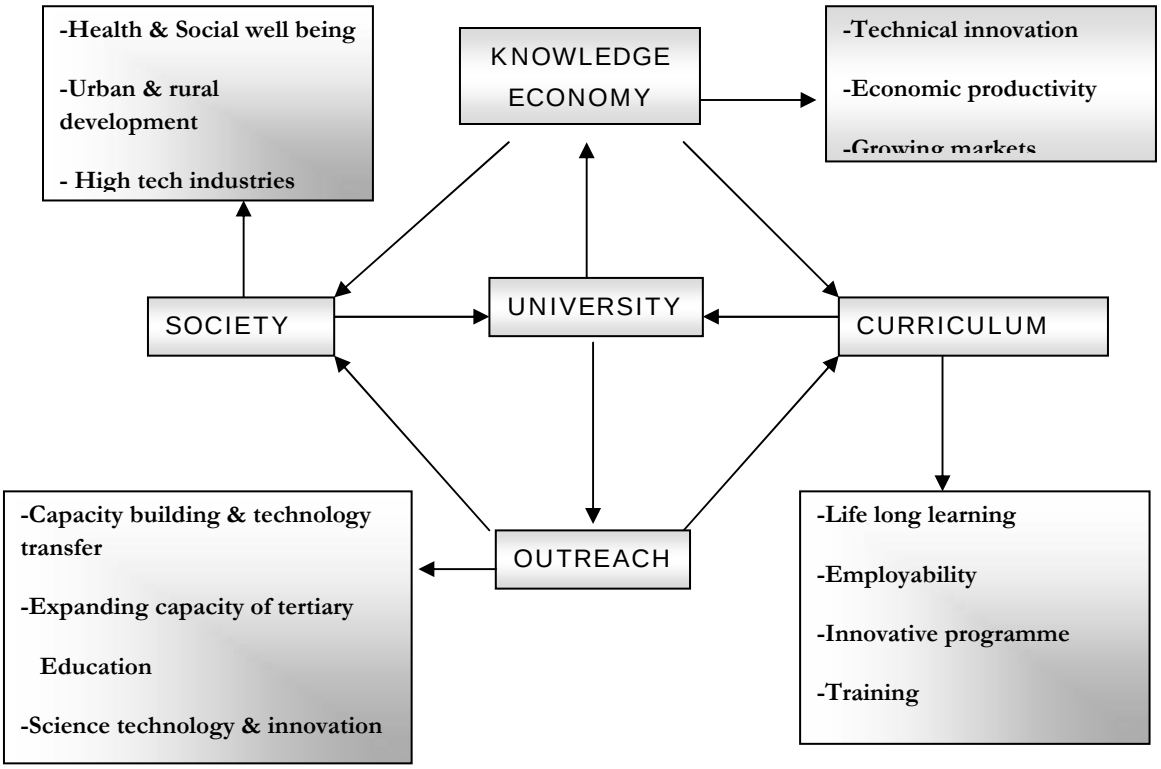
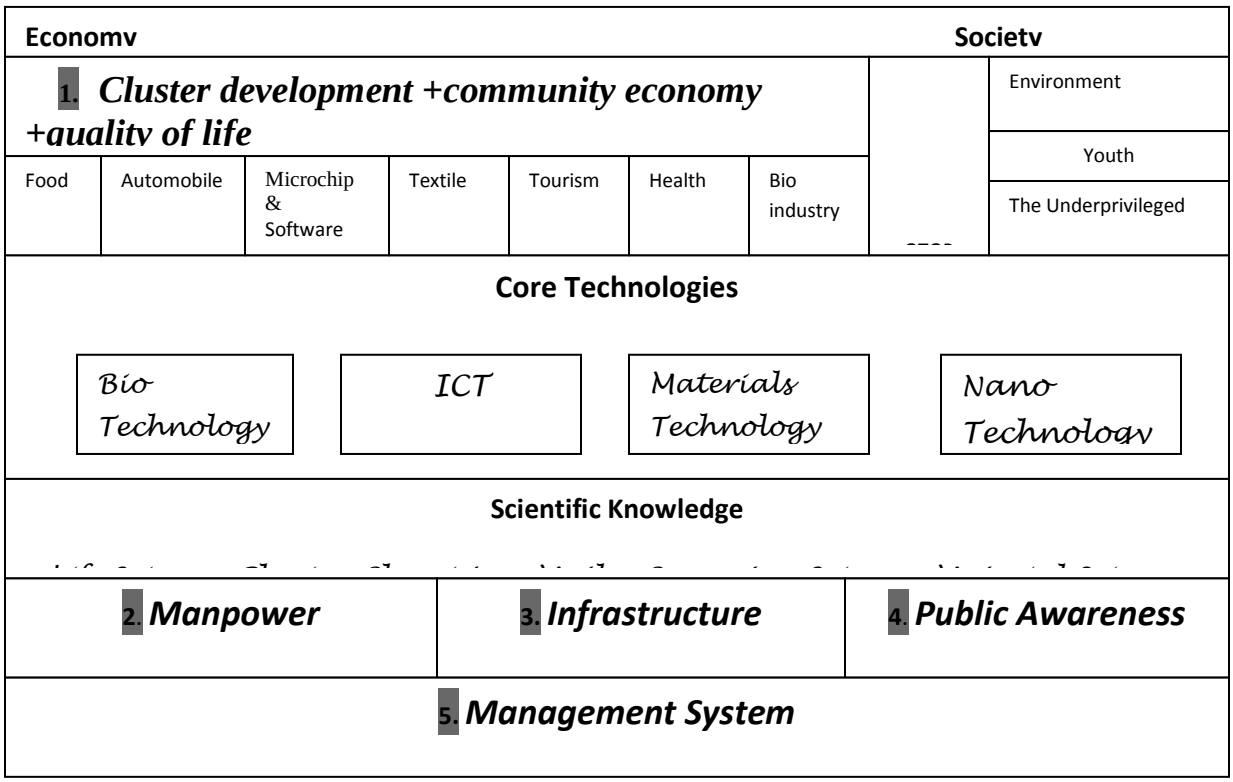
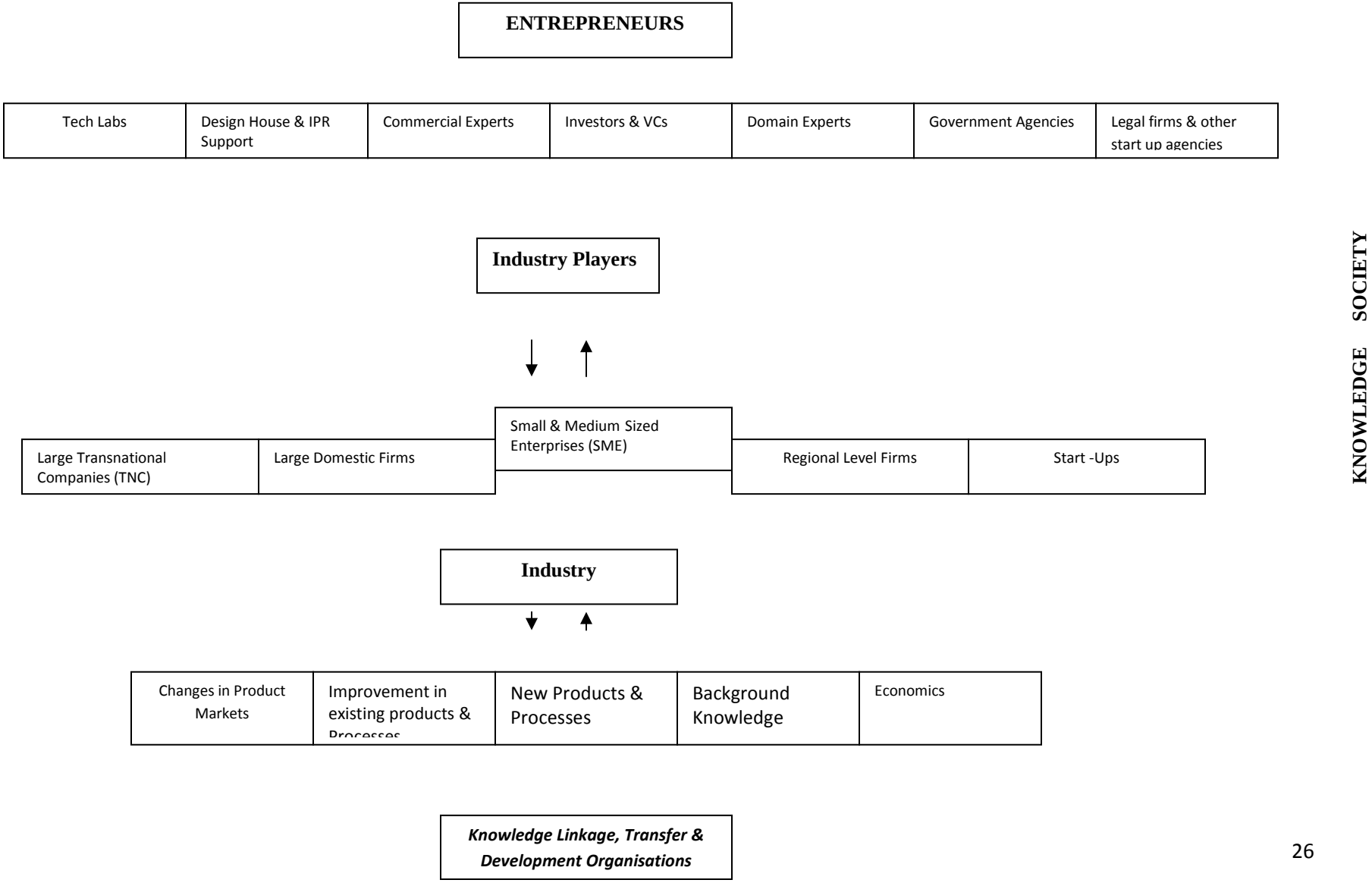


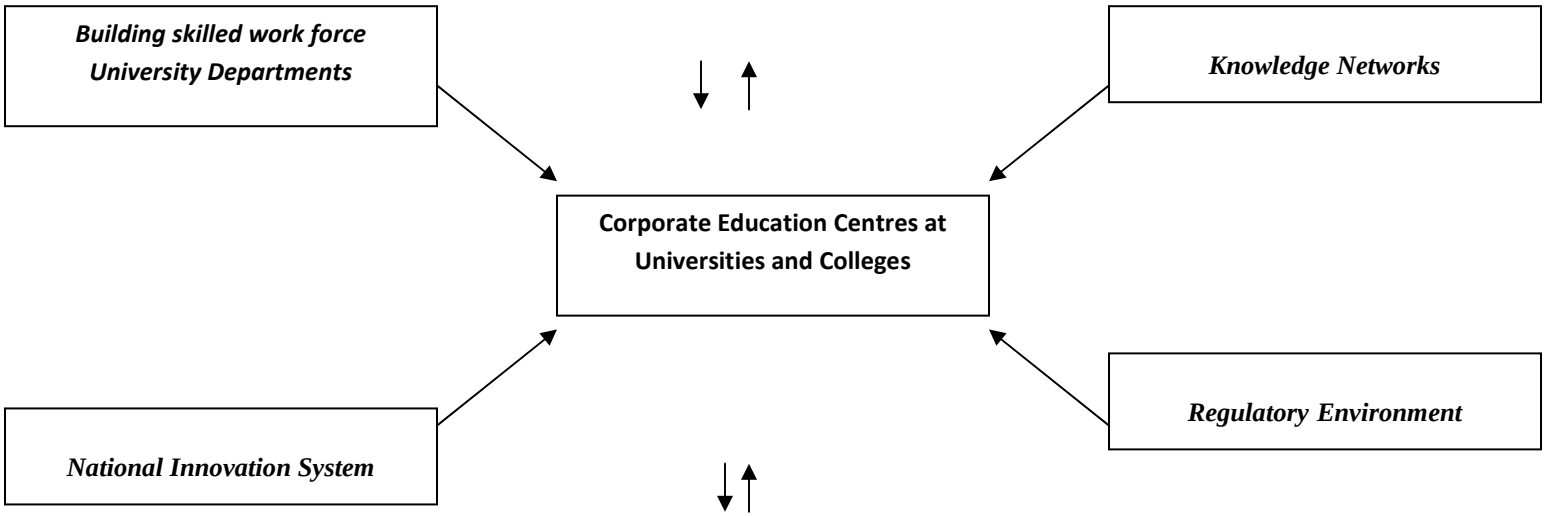
Figure 2: Framework of the Science and Technology Strategic Plan, 2004-13



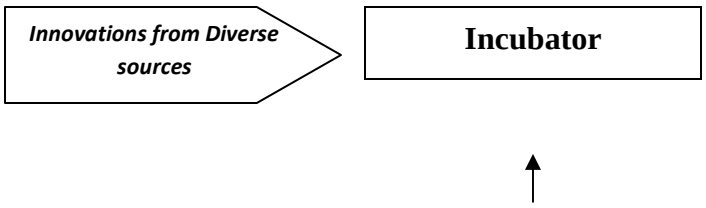
Source: NSTDA (2004)

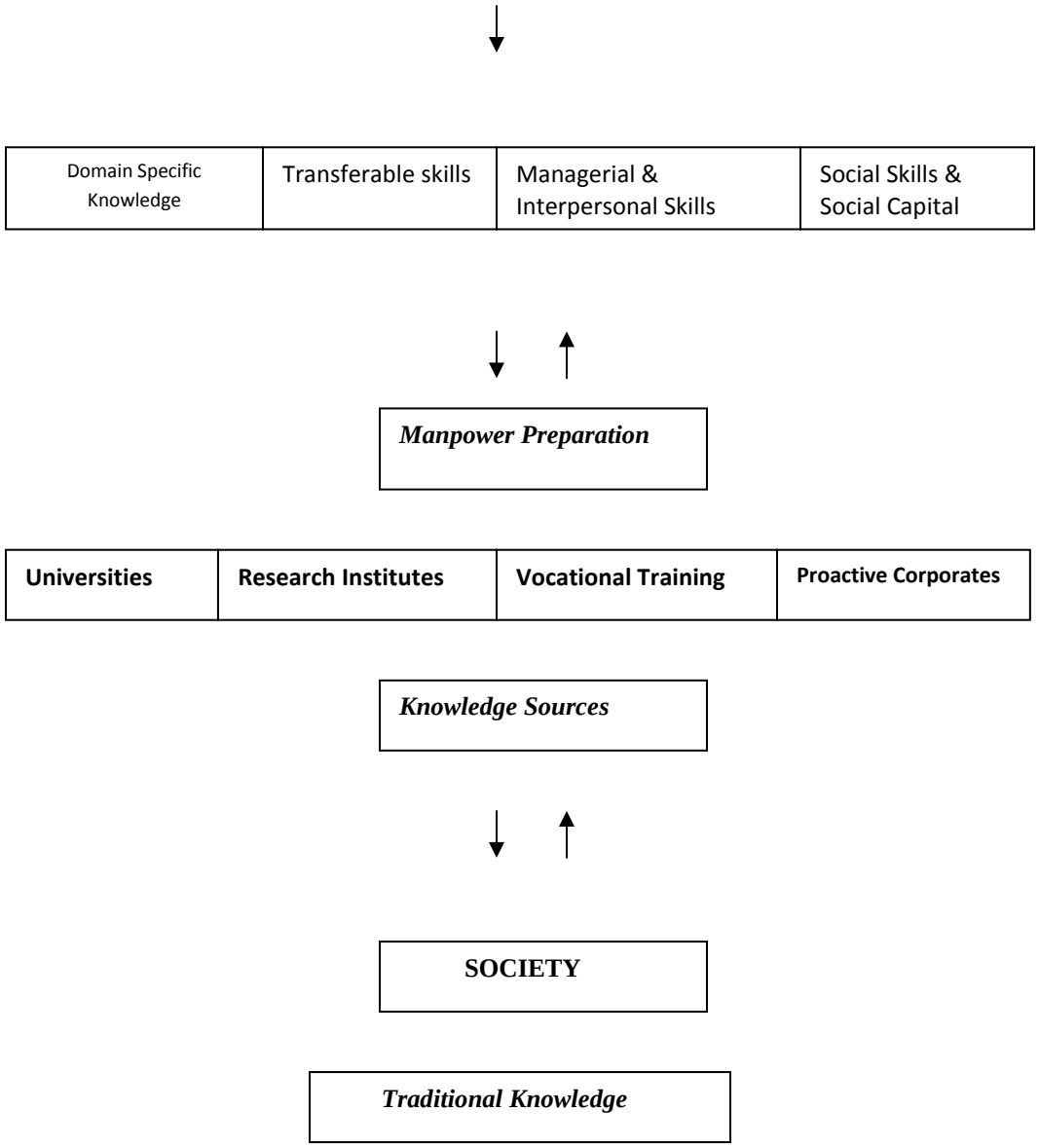
Figure 3: Ecosystem for Knowledge Linkage & Integration - Corporate Education Centres at Universities Colleges for KBE (Narasimharao, 2010b)





Academic & Technology Institutions	Technology Business Incubators (TBI)	Science & Technology Entrepreneurs Parks (STEP)	Government & Private firms	Centres of Excellence & Relevance




Domain Specific Knowledge
Transferable skills
Managerial & Interpersonal Skills
Social Skills & Social Capital
Manpower Preparation
Universities
Research Institutes
Vocational Training
Proactive Corporates
Knowledge Sources
SOCIETY
Traditional Knowledge